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THE CULTIVATION AND HANDLING OF GOLDENSEAL.

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DRUG-PLANT INVESTIGATIONS.

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THE CULTIVATION AND HANDLING OF GOLDENSEAL.^a

INTRODUCTION.

Few drugs on the American market have been subject to such wide fluctuations in price as goldenseal, the dried root of which forms one of the most important articles in the crude-drug trade of this country. While for many years high and low prices depended mostly upon the alternate scanty or oversupplied market, and while this, of course, still holds true to a certain extent with goldenseal as well as with other commodities, there seems little doubt now that the increased values of the past few years and the present unprecedented high prices may be attributed to the fact that the plant is fast becoming exterminated from American forests.

Although in some secluded localities goldenseal may still be found rather abundantly, the supply is rapidly diminishing, and there is a growing scarcity of the plant throughout its range. With the advance of civilization and the increase in population came a growing demand for many of our native medicinal plants and a corresponding decrease in the sources of supply. As the rich forest lands of the Ohio Valley and elsewhere were required for the needs of the early settlers they were cleared of timber and cultivated, and the goldenseal, deprived of the shelter and protection necessary to its existence, gradually disappeared, as it will not thrive on land that is cultivated. Where it

^a The increasing use of goldenseal in medicine has resulted in a wide demand for information about the plant, its identification, geographical distribution, the conditions under which it grows, the methods of collecting and preparing the rhizome, the relations of supply and demand, and the possibilities of cultivation. This paper, entitled "The Cultivation and Handling of Goldenseal," was prepared by Miss Alice Henkel, Assistant in Drug-Plant Investigations, and Mr. G. Fred Klugh, Scientific Assistant in the same office, under the direction of Dr. Rodney H. True, Physiologist in Charge, and is a revision of Bulletin No. 51, Part VI, of the Bureau of Plant Industry, entitled "Goldenseal." In the preparation of this paper, which was undertaken to meet the demand for information relative to goldenseal, now fast disappearing from our forests, many facts have been obtained from Lloyd's Drugs and Medicines of North America.—B. T. GALLOWAY, *Chief of Bureau*.

was not destroyed in this manner the root diggers, diligently plying their vocation, did their share toward exterminating this useful little plant, which they collected regardless of the season, either before the plants had made much growth in spring or before the seeds had matured and been disseminated, thus destroying all means of propagation. The demand for the root appears to be increasing, not only in this country but also abroad, and the cultivation of goldenseal seems now to have become a necessity in order to meet the demand and save the plant from extinction.

Prior to 1900 there seemed to be no one, so far as the Department of Agriculture could ascertain, who had ever attempted the cultivation of goldenseal for the market. From that time on many inquiries were directed to the Department by persons who were quick to note the upward tendency of prices for goldenseal, and there are now several growers in different parts of the country who have undertaken the cultivation of goldenseal on a commercial scale.

It is necessary, however, to remind prospective growers to proceed with caution, for if goldenseal is universally cultivated it will, of course, eventually result in overstocking the market and bringing about such a depression in price as to make goldenseal cultivation a profitless venture.

HABITAT AND RANGE OF GOLDENSEAL.

Goldenseal occurs in patches in high open woods where there is plenty of leaf mold and usually on hillsides or bluffs affording natural drainage, but it is not found in very moist or swampy situations, on prairie land, or in sterile soil. It is native from southern New York to Minnesota and western Ontario, south to Georgia and Missouri, ascending to an altitude of 2,500 feet in Virginia. It is now becoming scarce throughout its range. Not all of this region, however, produces goldenseal in abundance. Ohio, Indiana, Kentucky, and West Virginia have been the greatest goldenseal-producing States, while in some localities in southern Illinois, southern Missouri, northern Arkansas, and central and western Tennessee the plant, though common, can not be said to be sufficiently plentiful to furnish any large quantity of the root. In other portions of its range it is sparingly distributed.

DESCRIPTION OF THE PLANT.

In addition to "goldenseal," many other common names have been applied to this plant in different localities, most of them bearing some reference to the characteristic yellow color of the root, such as yellowroot, yellow puccoon, orange-root, yellow-paint, yellow Indian-paint, Indian-paint, goldenroot, Indian-dye, curcuma, wild curcuma,

Ohio turcuma, wild turmeric, Indian turmeric, jaundice-root, and yellow-eye; other names are eye-balm, eyeroot, and ground-raspberry. Yellowroot, a popular name for it, is misleading, as it has been applied to other plants also, namely, to goldthread, false bitter-sweet, twinleaf, and the yellowwood. The name goldenseal, however, derived from its yellow color and the seal-like scars on the root, has been generally adopted.

Goldenseal (*Hydrastis canadensis* L.) belongs to the same family as the buttercup, namely, the crowfoot family (Ranunculaceæ). It is a perennial plant, and the thick yellow rootstock sends up an erect, hairy stem about a foot in height, around the base of which are two or three yellowish scales. The stems as they emerge from the ground are bent over, the tops still remaining under ground, and sometimes the stems show some distance above the surface before the tops are brought out from the soil. The yellow color of the roots and scales extends partly up the stem so far as it is covered by soil, while the portion of the stem above ground has a purplish color. Goldenseal has only two leaves (rarely three), the stem bearing these seeming to fork at the top, one branch supporting a large leaf and the other a smaller one and a flower. Occasionally there is a third leaf, much smaller than the other two and stemless. The leaves are prominently veined on the lower surface, and are palmately 5 to 9 lobed, the lobes broad, acute, sharply and unequally toothed. The leaves are only partially developed at flowering time and are very much wrinkled, but they continue to expand until they are from 6 to 8 inches in diameter, becoming thinner in texture and smoother. The upper leaf subtends or incloses the flower bud. (Fig. 1.)

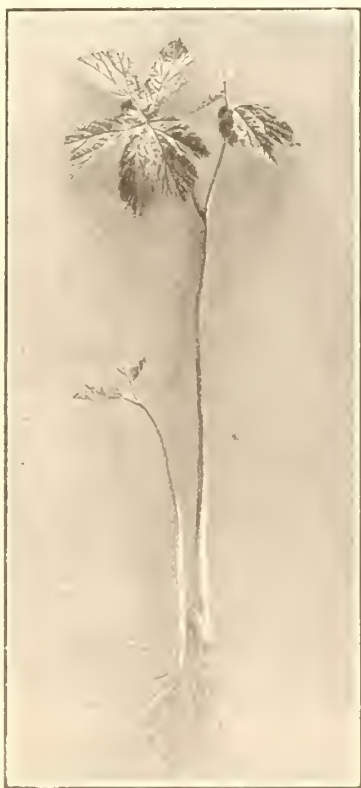


FIG. 1.—A flowering plant of goldenseal.

Early in spring, about April or May, the flower appears, but few ever see it, as it lasts only five or six days. It is greenish white, less than half an inch in diameter, and has no petals, but instead three small, petal-like sepals, which fall away as soon as the flower expands,

leaving only the stamens—as many as 40 or 50—in the center of which are about a dozen pistils, which finally develop into a round, fleshy, berry-like head. The fruit ripens in July or August, turning a bright red and resembling a large raspberry, whence the common name “ground-raspberry” is derived. Each fruit contains from 10 to 20

small, black, shining, hard seeds. (Fig. 2.)

If the season has been moist, the plant sometimes persists to the beginning of winter, but if it has been a dry season it dies down soon after the fruit is ripe, so that by the end of September no trace of the plant remains above ground. In a patch of goldenseal there are always many sterile stems, simple and erect, bearing a solitary leaf at the apex, but no flower.

Mr. Homer Bowers,^a of New Ross, Ind., who propagated goldenseal from seed for the purpose of study-



FIG. 2.—A fruiting plant and a fruiting branch of goldenseal.

ing its germination and growth, states that the plant grown from naturally sown seed often escapes observation during the first year of its existence owing to the fact that in this entire period nothing but two round seed leaves are produced, and at this stage the plant does not look materially different from other young seedlings. During its second year from seed one basal leaf is sent up, followed in the third year by another smaller leaf and the flower.

^a A Contribution to the Life History of *Hydrastis Canadensis*, Bot. Gaz., vol. 16, pp. 73-82, 1891.

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DESCRIPTION OF THE RHIZOME, OR ROOTSTOCK.

The rhizome (rootstock) and rootlets of goldenseal, or *hydrastis*, as it is also known in the drug trade, are the parts employed in medicine. The full-grown rhizome when fresh is of a bright yellow color both internally and externally, about $1\frac{1}{2}$ to $2\frac{1}{2}$ inches in length and from one-fourth to three-fourths of an inch in thickness. Fibrous yellow rootlets are produced from the sides of the rhizome. (Fig. 3.) The fresh rhizome contains a large amount of yellow juice and gives off a rank, nauseating odor. When dry the rhizome measures from 1 to 2 inches in length and from one-eighth to one-third of an inch in diameter. It is crooked, knotty, wrinkled, of a dull brown color outside, and breaks with a clean, short, resinous fracture, showing a lemon-yellow color if the root is not old. If the dried root is kept for a long time it will be a greenish yellow or brown internally, and becomes inferior in quality. On the upper surface of the rhizome are several depressions, left by former annual stems, which resemble the imprint of a seal; hence the name goldenseal. The fibrous rootlets become very wiry and brittle in drying, breaking off readily and leaving only small protuberances, so that the root as found in commerce is sometimes almost bare. The dried rhizome also has a peculiar, somewhat narcotic, disagreeable odor, but not so pronounced as in the fresh material, an exceedingly bitter taste, and a persistent acidity which causes an abundant flow of saliva when the rhizome is chewed. The most important constituents of the rhizome are the three alkaloids—hydrastin, berberin, and canadine. It contains also starch, albuminous matter, resin, sugar, fatty matter, and inorganic salts.



FIG. 3.—Rhizome, or rootstock, of goldenseal.

Hydrastis acts chiefly upon the mucous membranes and glandular system, and to some extent upon the nervous system. It is a valuable drug in disordered conditions of the digestive organs and in catarrhal affections of any of the mucous membranes when unaccompanied with acute inflammation. In the various diseases of the mucous membranes it is administered both internally and locally. *Hydrastis* imparts its properties to water, glycerin, or alcohol.

COLLECTION AND PREPARATION OF THE ROOT.

The root should be collected in autumn after the plants have matured seed. Spring-dug root shrinks far more in drying and always commands a lower price than the fall-dug root. After the roots are removed from the earth they should be carefully freed from soil and all foreign particles. They should then be sorted, and small, undeveloped roots and broken pieces may be laid aside for replanting. After the roots have been cleaned and sorted they are ready to be dried or cured. Great care and judgment are necessary in drying the roots. It is absolutely necessary that they should be perfectly dry before packing and storing, as the presence of moisture induces the development of molds and mildews, and of course renders them worthless. The roots are dried by exposure to the air, being spread out in thin layers on drying frames or upon a large, clean, dry floor. They should be turned several times during the day, repeating this day after day until the roots are thoroughly dried. If dried out of doors they should be placed under cover upon indication of rain and at night so that they may not be injured by dew. After the roots are thoroughly dried they may be packed as tightly as possible in dry sacks or barrels, and they are then ready for shipment.

BRIEF MEDICAL HISTORY.

As in the case of many other native medicinal plants, the early settlers learned of the virtues of goldenseal through the American Indians, who used the root as a medicine and the yellow juice as a stain for their faces and a dye for their clothing.

The Indians regarded goldenseal as a specific for sore and inflamed eyes, and it was a very popular remedy with the pioneers of Ohio and Kentucky for this affection, and also for sore mouth, the root being chewed for the relief of the last-named trouble. In the herbarium collected by Captains Lewis and Clark on their expedition to the source of the Missouri and across the country to the Pacific coast, a specimen of goldenseal collected May 24, 1804, bears some notes in the handwriting of Captain Lewis concerning the use of this plant in "Kentucky and many other parts of the western country." He states that it is said to be a sovereign remedy for sore eyes, describing the nature of this disorder and giving also the method of preparing and applying this remedy. He states, further, that it makes an "excellent mouth water."

Barton, in his "Collections for an Essay towards a Materia Medica of the United States," 1804, speaks of the use of a spirituous infusion of the root of goldenseal as a tonic bitters in the western part of Pennsylvania and of the employment of an infusion of the root in cold water as a wash for inflammation of the eyes.

According to Dr. C. S. Rafinesque, in his *Medical Flora* in 1828, the Indians also employed the juice or infusion for many "external complaints, as a topical tonic," and "some Indians employ it as a diuretic, stimulant, and escharotic, using the powder for blistering and the infusion for the dropsy." He states further that "internally it is used as a bitter tonic, in infusion or tincture, in disorders of the stomach, the liver," etc.

It was not until a demand was created for goldenseal by the eclectic school of practitioners, about 1847, that it became an article of commerce, and in 1860 the root was made official in the *Pharmacopœia* of the United States, which place it has held to the present day.

CULTIVATION.

The United States Department of Agriculture has been carrying on experiments in the cultivation of goldenseal on a small scale at Washington, D. C., since the spring of 1899, in the hope that methods might be worked out according to which this valuable wild drug plant could be grown on a commercial scale. In these experiments the aim has been to imitate the natural conditions of growth as closely as possible. The results that have thus far been obtained seem to justify the conclusion that goldenseal can be successfully cultivated. The methods of operation described apply to the conditions at Washington, and the treatment may need to be somewhat modified under other conditions of soil and climate.

NECESSARY SOIL CONDITIONS.

The soil conditions should imitate as closely as possible those seen in thrifty deciduous forests. The soil should contain an ample supply of humus, well worked into the ground, to secure the lightness and moisture-retaining property of forest soils. The best form of humus is probably leaf mold, but good results may be obtained by mulching in the autumn or early winter with leaves, straw, well-rotted stable manure, or similar materials. After the soil has been prepared and planted it is well to add a mulch in the fall as a partial protection to the roots during the winter, and the decay of this material adds to the value of the soil by the time the plants appear in the spring. The forest conditions are thus imitated by the annual addition of vegetable matter to the soil, which by its gradual decay accumulates an increasing depth of a soil rich in materials adapted to the feeding of the plants and to the preservation of proper physical conditions. The growth of weeds is also hindered to a considerable extent. If sufficient attention is given to the presence of this mulch, the nature of the underlying soil is of less importance than otherwise. In the case of clay the thorough incorporation of a large amount of decayed vege-

table matter tends to give lightness to the otherwise heavy soil, facilitating aeration and drainage. Since the roots of the goldenseal do not grow well in a wet soil, thorough drainage is necessary. A lighter, sandy soil is improved by the addition of humus, since its capacity to hold moisture is thereby increased and the degree of fertility is improved. The looser the soil, the easier it is to remove the roots in digging without breaking or injuring them. Before planting, the soil should be thoroughly prepared to a depth of at least 6 or 8 inches, so as to secure good aeration and drainage. The good tilth thus secured will be in a degree preserved by the continued addition of a mulch. A further advantage of careful preparation is seen in a decrease in the amount of cultivation required later.

FERTILIZERS.

The fertilizers that may be used with profit in the growing of goldenseal have not yet been determined, but it is probable that potash and phosphates would increase the yield, especially if the soil is light. So far as is known, no preference can be given to any particular compounds of either potash or phosphoric acid. Two hundred pounds of kainit or 50 pounds of muriate of potash and from 200 to 300 pounds of superphosphate per acre would in all probability prove useful. The nitrogen is supplied by the humus and need not be added in concentrated form.

ARTIFICIAL SHADE.

Since the goldenseal grows naturally in the woods, it must be protected from the full light of the sun by artificial shade. That used in connection with the experiments of the Department was made of ordinary pine plastering lath nailed to a suitable frame elevated on posts. The posts were of cedar 8½ feet long, set 2½ feet in the ground in rows 11 feet apart and 16 feet distant from each other in the rows. Supports 2 by 4 inches were set on cedar blocks 2 feet long sunk below the soil surface in the middle of the 16-foot spaces. Pine pieces 2 by 4 inches were nailed edgewise to the tops of the posts and supports. The posts were notched to receive the 2 by 4 inch sticks. Pieces 2 by 4 inches were nailed across these at intervals of 4 feet. The laths were nailed to these, leaving spaces about an inch wide.

This shade has been found to be satisfactory, as it is high enough above the ground to allow such work as is necessary in preparing and cultivating the land. If the lathing is extended 2 or 3 feet beyond the posts on the sunny sides, injury from the sun's rays will be prevented, or laths may be nailed vertically to the pieces of pine—2 by 4 inches at the top and a 4-foot strip below. The sides may be protected by portable board walls about 2 feet high set around the edges. Protection from injury by winds when the tops are large may be thus

secured. Too much dampness should be guarded against in the use of the board sides, since conditions might be developed favorable to the damping-off fungus and to aphides during hot rainy periods.

The cost of lath shade over a tenth of an acre at Washington was probably considerably greater than will be necessary in districts where lumber is cheaper. The lumber will probably cost from \$700 to \$800 per acre, and the labor of the farm can be utilized at times when other work is not pressing.

USE OF TREES AS SHADE.

Trees may be used for shade, but this is in some ways to be regarded as unsatisfactory. When the shade produced is of the right density, the use of moisture and raw food materials of the soil by the trees is an undesirable feature.

ATTENTION REQUIRED.

The cultivation of goldenseal is simple. Having secured a deep, loose soil, rich in humus renewed annually by the application of new mulch, the removal of weeds is the chief care. The soil, if properly prepared, will tend to maintain itself in good condition. The manner of treatment is very similar to that required by ginseng, which is also a plant of the moist woods. If the ground is thoroughly prepared, beds are not absolutely necessary. The plants may be grown in rows 1 foot apart and 6 inches apart in the rows. Beds may be thought by some to be more convenient, enabling the grower to remove the weeds and collect the seed more readily. If beds are used, they may be made 4 feet wide, running the entire length of the shade, with walks 18 inches wide between. Boards 6 or 8 inches wide are set up around the sides of the beds, being held in place by stakes on each side of the boards in the center and at the ends. These beds are filled with prepared soil, and the plants are set 8 inches apart each way.

METHODS OF PROPAGATION.

There are three possible ways of propagating the plant: (1) By seed, (2) by division of the rhizomes (fig. 4), and (3) by means of small plants formed from buds on the stronger fibrous roots (fig. 5). The second method will prove satisfactory as a regular practice, but the third has value where the roots are not divided every year. Propagation by seed has the disadvantage of requiring several years to produce a crop, being of special value where the outlay is necessarily small and time is not an object.

EXPERIMENTS WITH SEEDS.

Seeds planted just after ripening, July 11, 1904, in sandy soil mixed with well-rotted stable manure and lightly mulched with manure

gave a few plants in the spring of 1905. Other lots saved and planted the following spring produced no plants. A number of germinated seeds sent in by a goldenseal grower and planted in March, 1907, in sandy soil well supplied with humus and lightly mulched came up well about the 1st of May and grew nicely. The experiments made by the Bureau of Plant Industry thus far have shown that about 30 per cent of the seedlings developed one or two true leaves, although in the majority only the seed leaves appeared in the first year (fig. 6).

Stratification of the seed after ripening, in a mixture of sand and leaf mold, as in the case of ginseng, insures the highest percentage of germination, provided it is properly done. The essentials of stratification are: (1) Sufficient moisture to cause softening of the



FIG. 4.—Rhizome, after division.

seed coat and prevent drying out of the seed and (2) a low temperature to prevent either rotting or germination. The usual procedure in seed stratification is as follows: A mixture of fine sand and leaf mold is sifted with a screen that will not allow the seed to pass through; the seeds, separated from the pulp, are then mixed with this in sufficient quantity to keep them separated and are put in a wooden box. If the box is very small, it may be put in a large box of sand and kept in a cool cellar or left out of doors covered with a cloth sack in a shaded place. The seeds can be sifted out when ready for planting the following spring. Where only a few seeds are produced, it is probably best to plant them in light, loamy soil under shade and mulch lightly with leaf mold or well-rotted manure. It is advisable,

especially in the beginning, to buy germinated seed in preference to ungerminated seed, and thus avoid the losses from old or poorly developed seed and from mistakes in handling.

EXPERIMENTS WITH DIVIDED RHIZOMES.

In the spring of 1902, 40 plants were secured and planted under a shade of a temporary character, but the season was too far advanced to permit of much growth during that year. In 1903 proper shade was supplied, all other conditions were better, and the plants made a good growth. The crop was dug about the middle of November, 1903; the roots were weighed and divided. They were again planted and in May, 1904, there were found to be 150 strong plants and a few smaller ones as a result of this division, an increase of 275 per cent. This method of propagation seems to be the most important and the other two of secondary importance. The processes are simple and no skill is needed. The plant dies down in late summer and the stem decays, leaving a scar in its place on the rhizome. Two or more buds are formed on the sides of the rhizome and these accumulate energy for growth the following spring. If the root is cut into pieces, giving each plant a portion of the rhizome, some fibrous roots, and one or more buds (fig. 1), the number of the plants can be doubled. The roots are planted and mulched and the process is complete. The rains pack the soil around the roots and they are ready to grow when spring comes. The process may be repeated every year and the number of roots increased indefinitely.



FIG. 5.—Plant formed from bud on fibrous root of goldenseal

Since 1904 the small plat mentioned has been used as a source for laboratory, botanical, and photographic material. There have been some losses from experiments in connection with the time of planting and transplanting and from using fresh manure as a mulch, yet the number of plants left is about the same as in 1904. It has been found best to do all planting of rhizomes while they are dormant. Roots

moved after the buds have begun growth in the spring either die or are retarded in growth so much that a season is lost unless the conditions are very favorable for a hasty and careful transfer.

EXPERIMENTS WITH PLANTS FROM FIBROUS ROOTS.

The stronger fibrous roots of the larger plants dug in the autumn of 1903 were found to contain buds, which were formed from a few inches to a foot from the rhizome. (Fig. 7.) Some were about half an inch long, but the majority of them were smaller. The larger ones need no special treatment and may be planted with the main crop.



FIG. 6.—Seedlings of goldenseal.

The smaller ones should be planted in boxes or beds of well-prepared soil at a distance of about 3 inches apart, mulched with a thin coating of leaf mold or similar material, and grown in shade until large enough to transplant to the shelter with the larger plants. They will probably require at least three years to reach their full development. If they could be left undisturbed in the beds where they are formed they would receive nourishment from the older rhizomes and perhaps grow faster, but it is probably best to divide the older roots every year where propagation alone is desired, planting the smaller roots and the plants made by division of the rhizomes. The larger roots are marketed to more advantage than the smaller ones, so it is best to have the surplus consist of the larger roots. The frequent working of the soil allowed by this treatment will keep it in better condition than if left undisturbed for a longer period.

YIELD OF ROOTS.

The yield obtained by the Department from small plats has been at the rate of 5,000 to 6,000 pounds of green roots per acre, which on

drying was reduced to 30 per cent, making about 1,500 pounds per acre. The yield from small plats can not be calculated as accurately as from larger areas, but these figures constitute a good basis for a conservative estimate.

TIME NECESSARY TO MATURE THE CROP.

The number of years necessary to produce a maximum crop depends on local conditions governing the growth. No advantage can come from growing goldenseal more than three years, because the roots begin to decay at the oldest scar after the fourth year, thus destroying the central and largest part of the root, leaving two or more small plants in place of the old. For propagation alone one year will give good results, while for maintaining a constant area two or three years, depending upon the growth made, will give a good crop of marketable roots.

HYDRASTIN CONTENT OF CULTIVATED ROOTS.

A sample was taken from roots dug October 18, 1907, the roots having been grown six successive seasons by the Department, being divided and transplanted several times. The assay made by Mr. A. F. Sievers, October 21, 1907, in accordance with



FIG. 7.—Goldenseal, showing bud and fibrous root.

the process described in the United States Pharmacopœia, Eighth Revision, showed a hydrastin content of 2.98 per cent. This is considerably above the requirements of the Pharmacopœia, which call for 2.50 per cent of hydrastin. According to Culbreth^a the hydrastin content of hydrastis roots varies from 1.5 to 3.14 per cent.

The cultivated roots show a hydrastin content very near the uppermost limit, such as one would expect from healthy roots dug in the fall and carefully washed and dried; therefore, it seems as if cultivation does not influence the hydrastin content, except to the extent of causing a normal high percentage of roots that are healthy and well nourished.

^aA Manual of Materia Medica and Pharmacology, 3d ed., p. 181.
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MARKET CONDITIONS.

Goldenseal is a root the price of which has fluctuated widely, because of the alternate oversupply and scarcity, the manipulation of the market, lack of demand, or other influences. High prices will cause the diggers to gather the root in abundance, thus overstocking the market, which the next season results in lower prices, at which diggers refuse to collect the root, thus again causing a shortage in the supply. Lack of demand usually brings about a shrinkage in price, even though the supply is light, while an active demand will cause prices to advance in spite of a plentiful supply. The arrival of spring-dug root has a weakening effect on the market, although the fall-dug root is always preferred. For the past few years, however, high prices have been steadily maintained, and there appears to be but one cause for this, and that is, as already pointed out, that the forests no longer yield unlimited quantities of this valuable root, as in former years, and the scanty supply that can be had is inadequate to meet the constantly increasing demand.

HIGHEST AND LOWEST PRICES.

The following table, taken from files of the Oil, Paint, and Drug Reporter, shows the highest and lowest prices quoted for goldenseal in the New York market each month during the past ten years, and also the highest and lowest points touched each year from 1898 to 1907, inclusive. The figures are based on the closing quotations of each successive week:

Month.	1898.		1899.		1900.		1901.		1902.		1903.		1904.		1905.		1906.		1907.	
	H.	L.	H.	L.	H.	L.	H.	L.	H.	L.	H.	L.	H.	L.	H.	L.	H.	L.	H.	L.
January.....	40	38	43	43	60	60	57	55	50	50	54	52	0.75	0.74	1.55	1.55	1.30	1.27½	1.50	1.45
February.....	45	40	70	43	60	58	56	55	50	50	51	54	1.25	.76	1.65	1.60	1.25	1.25	1.45	1.45
March.....	12½	38	70	62½	57	54	55	53	52	48	51	51	1.25	1.10	1.65	1.65	1.20	1.20	1.45	1.45
April.....	45	40	70	68	54	54	52	50	52	50	54	51	1.15	1.10	1.65	1.50	1.20	1.18	1.47½	1.45
May.....	50	45	75	60	51	53	49	49	52	50	51	54	1.20	1.15	1.55	1.45	1.18	1.15	1.47½	1.46
June.....	48	40	60	55	50	50	47	45	52	51	54	53	1.10	1.00	1.50	1.40	1.18	1.15	1.50	1.46
July.....	40	35	53	49	50	47½	57½	43	52	51	53	53	1.10	.90	1.35	1.30	1.10	1.30	1.50	1.48
August.....	50	38	52	50	54	47½	58	57½	52	52	57½	53	1.50	1.15	1.30	1.25	1.30	1.30	1.60	1.48
September.....	45	45	52	50	60	55	58	50	54	52	75	70	1.40	1.35	1.20	1.20	1.40	1.30	1.75	1.65
October.....	50	45	58	56	55	55	54	50	54	54	75	74	1.40	1.40	1.40	1.20	1.65	1.40	2.10	1.85
November.....	52	47½	60	58	58	55	52	52	53	52	74	74	1.41	1.35	1.37½	1.35	1.60	1.60	2.10	1.90
December.....	17½	45	62½	60	58	57	52	52	52	52	74	74	1.55	1.35	1.35	1.30	1.55	1.50	1.90	1.82½
Whole year.....	50	35	75	43	60	47½	58	43	51	48	75	52	1.55	.74	1.65	1.20	1.65	1.15	2.10	1.45

According to the market reports contained in the Oil, Paint, and Drug Reporter, the year 1908 opened with a quotation of \$1.85 a pound, the price advancing steadily until at the present writing, the end of the first quarter, the minimum is \$2, and the maximum \$2.10. There has been a good export demand, and it is reported that primary stocks are almost exhausted. It is yet too early for the spring-dug root, which, though less desirable than the fall-dug root,

nevertheless generally has the effect of lowering prices somewhat. The fall-dug root is not due on the market until about six months later. Meantime the outlook for continued high prices is believed to be favorable.

It is impossible to ascertain the exact annual consumption of golden-seal root, but the estimates furnished by reliable dealers place these figures at from 200,000 to 300,000 pounds annually, about one-tenth of which is probably used for export.

It will be observed that the price of this article is very sensitive to market conditions, and it seems probable that the point of over-production would be easily reached if a large number of golden-seal growers were to meet with success in growing extensive areas of this drug.

Approved:

JAMES WILSON,

Secretary of Agriculture.

WASHINGTON, D. C., April 11, 1908.

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